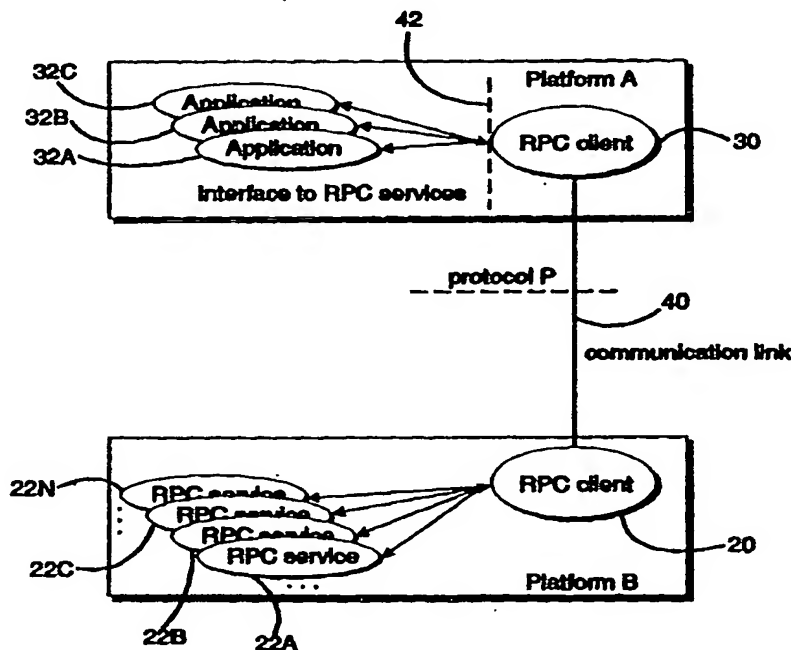# PCT

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(54) Title: REMOTE PROCEDURE CALL TRANSLATION

(57) Abstract

A remote procedure call (RPC) client (30) operates on a first level language platform and forwards a request for a RPC service to a second level language platform. The RPC client (30) includes an RPC service table (52) having a plurality of keys (60) stored therein as well as translation description memory (51) having a plurality of translation descriptions. When an applications program (32) on the first level language platform requests an RPC service of the second level language platform, a main interface process (50) of the RPC client obtains an appropriate one of the keys (60) from the RPC service table (52) and uses the appropriate one of the keys to select an appropriate one of the plurality of translation descriptions. A translation engine (54) uses the appropriate one of the plurality of translation descriptions to prepare a protocol formatted message for forwarding to the second level language platform. The protocol formatted message includes the appropriate one of the keys. A response from the RPC service of the second level language platform also includes a key which is used by the RPC client (30) to translate the response back to the first level language.

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REMOTE PROCEDURE CALL TRANSLATION

BACKGROUND

1. Field of Invention

This invention pertains to translation between data
5 structures operative on differing but communicating
computerized platforms.

2. Related Art and Other Considerations

10 Many computerized products actually require several computers
or computer systems to accomplish specified functions. The
constituent computer systems of such a product are typically
each considered to be a "platform", and are connected by a
physical communications link such as a cable. Each platform
15 executes software in the form of sets of instructions coded
in accordance with a particular software or programming
language.

The platforms are typically configured for differing
20 purposes. For example, software executed by one platform may
comprise hardware "drivers" for controlling actual hardware
equipment, while the software executed by another platform
may be managerial or administrative. An example is a
telecommunications access product, in which one platform
25 controls a piece of telecommunications hardware while another
platform performs administrative or supervisory functions.

2

In some situations the software or programming language for one platform is more "high level" than the programming language for the other platform. By "high level" is meant that the programming language is more sophisticated, more
5 complex, or more specialized than the programming language of the other platform. Typically each platform has one or more data structures in its programming language. Despite the differing levels of language, the two platforms must nevertheless communicate, e.g., data from the differing data
10 structures must be passed back and forth between the platforms. Typically there is a predetermined protocol involved as an interface between e.g., the data structures of the two platforms.

15 One context requiring translation is required when one platforms accesses a different-level data structure running on another platform by use of a remote procedure call, known as an "RPC", to a remote procedure service. Remote procedure calls are described, for example, in U.S. Patent 5,568,723;
20 U.S. Patent 5,515,508; and U.S. Patent 5,307,490, all of which are incorporated herein by reference. In such context, remote procedure call (RPC) libraries can be employed for translation. These RPC libraries use standard functions to pack and unpack simple data types into/from the protocol.
25 Unfortunately, such PRC libraries are typically accessible only when using more common programming languages, and are often not as available for less frequently utilized programming languages. For the less common programming languages, the cost of developing a PRC library can be quite
30 high.

Another approach for translation using remote procedure calls
(RPCs) is preparation of a proprietary object which
interfaces with the remote procedure service and which
provides packaging and unpackaging services. Implementation

5   of such an approach also has considerable cost.

What is needed, therefore, and an object of the present
invention, is a simple and flexible translation between data
structures used in languages of differing levels.

10

SUMMARY

A remote procedure call (RPC) client operates on a first
level language platform and forwards a request for a RPC

15   service to a second level language platform. The RPC client
includes a RPC service table having a plurality of keys
stored therein as well as translation description memory
having a plurality of translation descriptions. When an
applications program on the first level language platform

20   requests an RPC service of the second level language
platform, a main interface process of the RPC client obtains
an appropriate one of the keys from the RPC service table and
uses the appropriate one of the keys to select an appropriate
one of the plurality of translation descriptions. A

25   translation engine uses the appropriate one of the plurality
of translation descriptions to prepare a protocol formatted
message for forwarding to the second level language platform.
The protocol formatted message includes the appropriate one
of the keys. A response from the RPC service of the second

30   level language platform also includes a key which is used by
the RPC client to translate the response back to the first

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level language.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The foregoing and other objects, features, and advantages of
the invention will be apparent from the following more
particular description of preferred embodiments as
illustrated in the accompanying drawings in which reference
characters refer to the same parts throughout the various
10 views. The drawings are not necessarily to scale, emphasis
instead being placed upon illustrating the principles of the
invention.

Fig. 1 is a schematic view of two differing computerized
15 platforms, one of the platforms including a PRC server and
the other of the platforms including a RPC client.

Fig. 2 is a schematic view of an embodiment of the RPC client
of Fig. 1.
20

DETAILED DESCRIPTION OF THE DRAWINGS

In the following description, for purposes of explanation and
not limitation, specific details are set forth such as
25 particular architectures, interfaces, techniques, etc. in
order to provide a thorough understanding of the present
invention. However, it will be apparent to those skilled in
the art that the present invention may be practiced in other
embodiments that depart from these specific details. In
30 other instances, detailed descriptions of well known devices,
circuits, and methods are omitted so as not to obscure the

description of the present invention with unnecessary detail.

Fig. 1 shows two computerized platforms, particularly
platform B and platform A. Platform B, known as the lower
5   level language platform, has a RPC server 20 and a plurality
of RPC services 22A - 22N. Platform A, known as the higher
level language platform, has a RPC client 30 and a plurality
of applications 32A - 32C (three such applications being
shown as an example). RPC server 20 and RPC client 30 are
10 connected by communications link 40 for which there is a
protocol P for translation between platform A and platform B.
Between RPC client 30 and applications 32A - 32C is an RPC
service interface 42.

15 An example of the lower level language executing on platform
B can be an imperative language such as the "C" programming
language, while a higher level language such as Prolog, Lisp,
or variants thereof may be executing on platform A. PRC
server 20 of platform B is included in software executing on
20 platform B. PRC server 20 dispatches RPC requests received
from platform A to different ones of the PRC services 22.

PRC client 30 of the present invention performs a simple and
flexible translation of the higher level language data
25 structures employed on platform A towards protocol P. In
addition, PRC client 30 provides a transparent interface to
other applications executing on platform A.

Fig. 2 shows PRC client 30 as including main interface
30 process 50; translation description memory 51; RPC service
table 52; translation engine 54; an add/remove/lookup service

56; and, communication interface 58. Communication interface
58 is connected to communications link 40.

RPC service table 52 is stored in a memory (e.g., RAM) and
5   has, at corresponding addresses, a plurality of RPC items
represented by items 60A - 60K. Each item has as one of its
fields an RPC service identifier as a key, e.g., keys 62A -
62K being shown in Fig. 2.

10   In accordance with the present invention, one of the
applications 32 running on platform A, known as the calling
application, requests one of the RPC services 22 executing on
platform B. The request, in the form of a remote procedure
call, can include procedure arguments, e.g., parameters to be
15   passed to the RPC service 22 for utilization thereby in
performance of the PRC service. The request by the calling
application 32 is made over interface 42 to main interface
process 50 of platform A.

20   Dependent on which of the particular applications 32 is the
calling application, and the nature of the request (e.g., the
particular RPC service to be performed), main interface
process 50 uses add/remove/lookup service 56 to consult RPC
service table 52 in order to locate an appropriate one of the
25   items 60 in RPC service table 52 for the RPC service request.
Once the appropriate item 60 is located in RPC service table
52, a key 62 is extracted therefrom. The extracted key 62 is
then given to main interface process 50, which retrieves a
translation description based on this key from translation
30   description memory 51. Typically, translation description
memory has a different translation description for each key.

In essence, each translation description includes instructions or criteria for enabling a translation from the higher level language of platform A to protocol P.

5   Upon retrieval of the translation description from memory 51, the translation description and arguments for the PRC service are sent by main interface process 50 to translation engine 54. Translation engine 54 uses the translation description and RPC arguments of the higher level language of platform A
10   to prepare a protocol P-formatted message. The key 62 is also included in the protocol P-formatted message. The protocol P-formatted message is applied via communications interface 58 to link 40 for transmission to RPC server 20 of platform B.

15

At platform B, the protocol P-formatted message is processed, interpreted by RPC server 20, and forwarded to a particular one of the RPC services in accordance with the request from the calling applications program 32. The particular RPC
20   service which was invoked by the calling applications program prepares a response which is forwarded in a protocol P-formatted response message over link 40 to platform A. The forwarded response also includes a key 62, which in some cases can be the same key which was transmitted from platform
25   A to platform B in connection with the RPC service request.

The protocol P-formatted response message received on link 40 is received at communication interface 58 where it is processed and forwarded to main interface process 50. At
30   main interface process 50, the key 62 included in the response message is extracted. Based on the extracted key

62, a suitable translation description is obtained from
translation description memory 51. The translation
description and the P-formatted response message are then
forwarded to translation engine 54 for translation back to
5   the higher level language data structure utilized by the
calling application. After preparation of the translation in
the higher level language, the translated response is sent by
main interface process 50 to the calling application 32,
i.e., the application that requested the RPC service.

10

RPC service table 52 is dynamically configurable so that new
items can be added, old items removed, or existing items
retrieved and/or modified, e.g., in accordance with the
particular services 22 provided on platform B.
15 Add/remove/lookup service 56 facilitates these operations,
and communicates over interface 42 with the applications
programs 32.

The present invention provides a cost effective
20 implementation of RPC service where different platforms pose
translation problems for the communication protocol. The
present invention is particularly suitable for higher level
language implementations and provides straightforward
translations of symbols, lists, and complex data structures.
25

While the invention has been particularly shown and described
with reference to the preferred embodiments thereof, it will
be understood by those skilled in the art that various
alterations in form and detail may be made therein without
30 departing from the spirit and scope of the invention.
The embodiments of the invention in which an exclusive

property or privilege is claimed are defined as follows:

·10

CLAIMS

1. A remote procedure call (RPC) client operating on a first level language platform and which forwards a request for a
5 RPC service to a second level language platform, the client comprising:

a RPC service table having a plurality of keys stored therein;

10

a translation description memory having a plurality of translation descriptions stored therein;

a translation engine;

15

a main interface process which, based on the request for the RPC service, obtains an appropriate one of the keys from the RPC service table and uses the appropriate one of the keys to select an appropriate one of the plurality of translation
20 descriptions; and

wherein the translation engine uses the appropriate one of the plurality of translation descriptions to prepare a protocol formatted message for forwarding to the second level
25 language platform, the protocol formatted message including the appropriate one of the keys.

2. The apparatus of claim 1, wherein the RPC service table is dynamically configurable for selective inclusion and removal
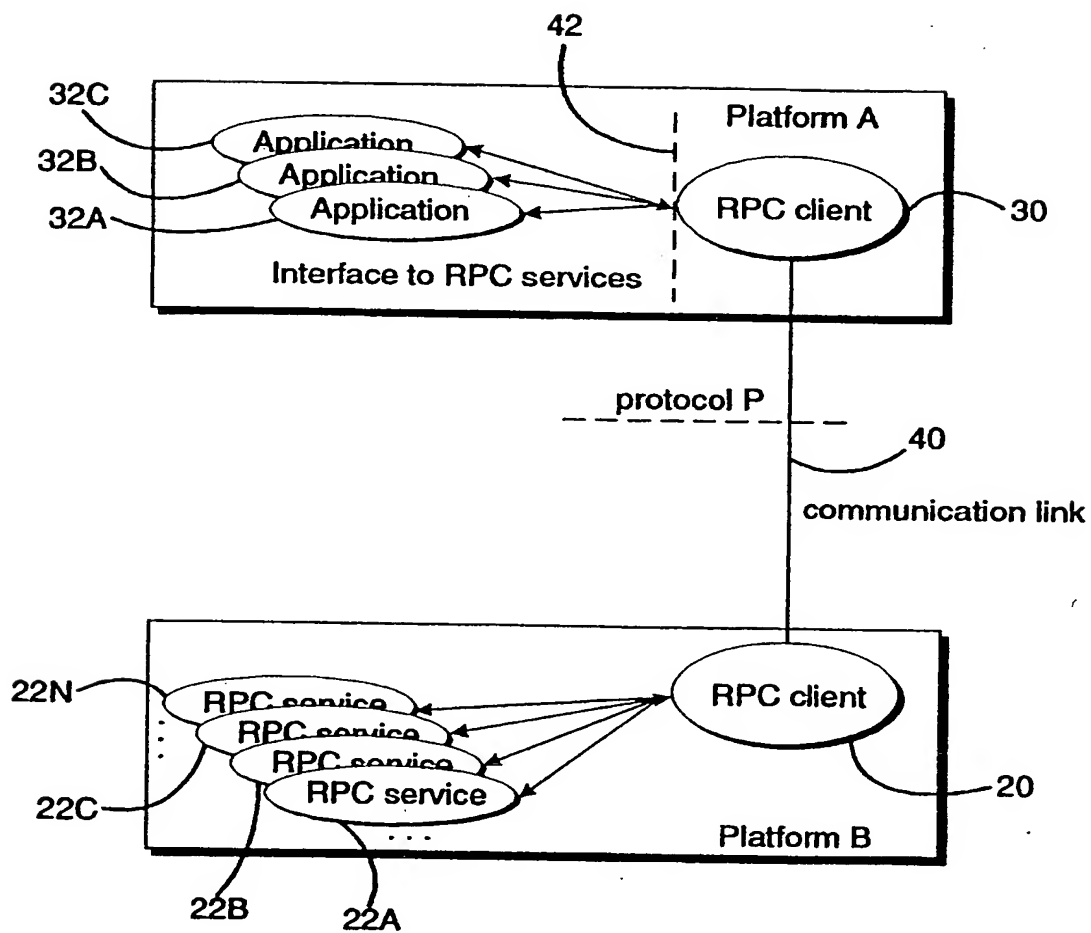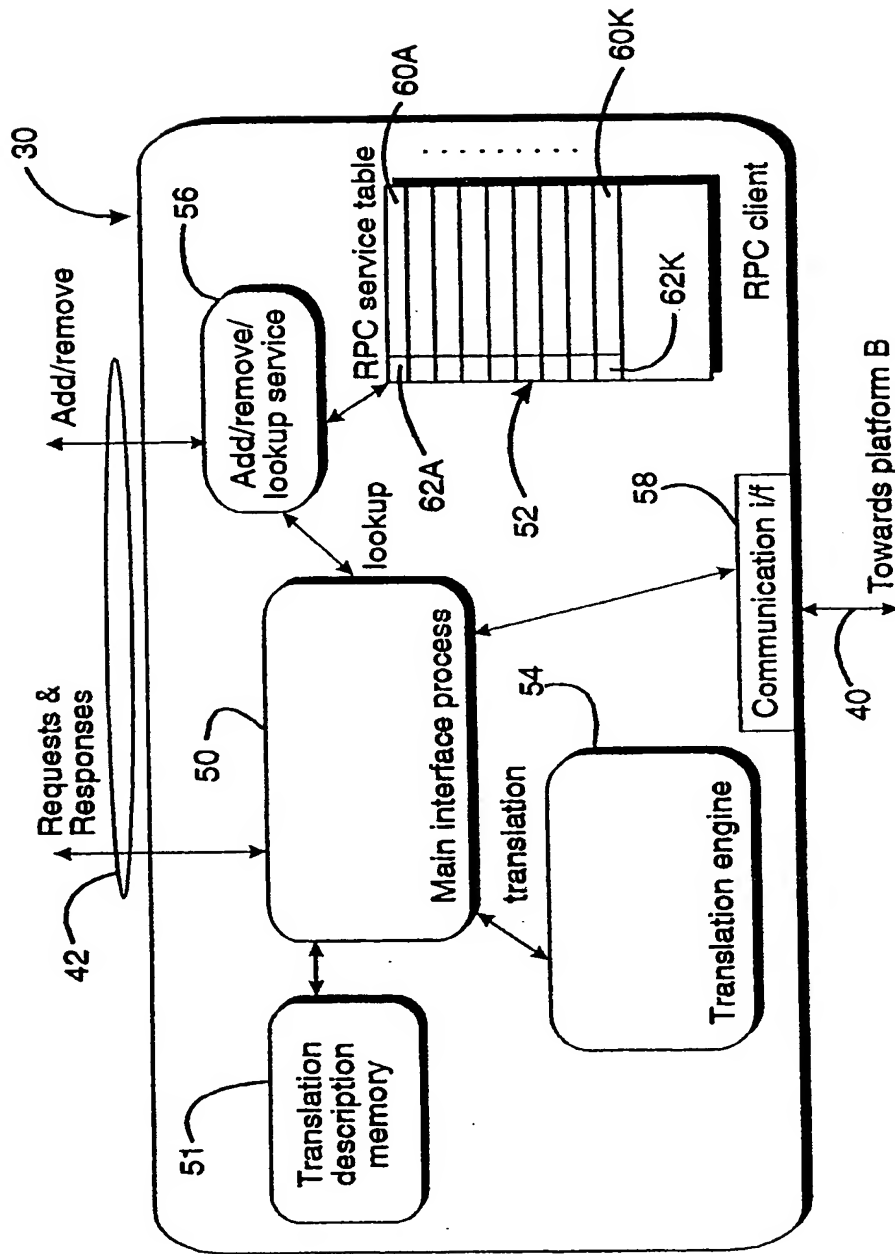30 of RPC services.

FIG. 1

FIG. 2

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   G06F9/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6   G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DAVE A ET AL: "PROXIES, APPLICATION INTERFACE, AND DISTRIBUTED SYSTEMS" PROCEEDINGS INTERNATIONAL WORKSHOP ON OBJECT ORIENTATION IN OPERATING SYSTEMS, 24 September 1992, pages 212-220, XP002009478 see abstract see page 217, left-hand column, last paragraph - page 218, right-hand column, paragraph 1	1,2
Y	EP 0 414 624 A (IBM) 27 February 1991 see the whole document	1,2
	-/--	

[X] Further documents are listed in the continuation of box C.   [X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 November 1998	12/11/1998

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	HERRICK J. JOHNSON: "Each piece in its place" UNIX REVIEW, vol. 5, no. 5, June 1987, pages 66-75, XP002082766 see page 73, right-hand column, line 8 - page 74, right-hand column, line 46	1,2
A	WO 97 08616 A (BELL COMMUNICATIONS RES) 6 March 1997 see the whole document	1,2
A	NARENDER V R ET AL: "DYNAMIC RPC FOR EXTENSIBILITY" PROCEEDINGS OF THE ANNUAL INTERNATIONAL PHOENIX CONFERENCE ON COMPUTERS AND COMMUNICATIONS, SCOTTSDALE, APR. 1 - 3, 1992, no. CONF. 11, 1 April 1992, pages 93-100, XP000310598 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see the whole document	1,2

4

INTERNATIONAL SEARCH REPORT

Information on patent family members

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			DE	69029441 T	12-06-1997
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WO 9708616	A	06-03-1997	NONE		